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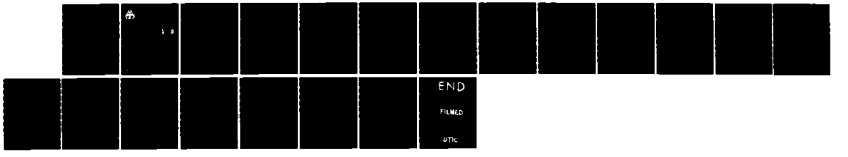

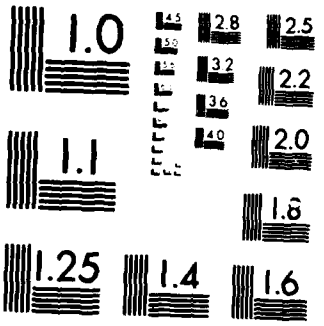

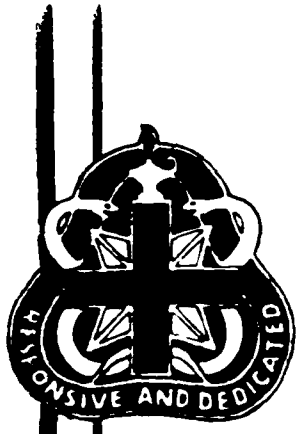

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United States Army Health Care Studies and Clinical Investigation Activity

VARIABLES AFFECTING COMPLIANCE WITH GENERAL MEDICAL RECOMMENDATIONS

by

LTC John A. Coventry

Consultation Report #85-005

February 1985

US ARMY
HEALTH SERVICES COMMAND
FORT SAM HOUSTON, TEXAS 78234

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A statistical consultation performed to determine significant variables affecting the rate of surgeons' compliance with recommendations resulting from consultations with internists. The consultation was based on a six month study of compliance which produced data on 419 consultations, resulting in 1705 recommendations. A summary of the important statistical results is provided in the report. All statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS). Keywords:

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Consultation
Report # 85-005

VARIABLES AFFECTING COMPLIANCE WITH GENERAL MEDICAL RECOMMENDATIONS

A Consultation Report for the Chief, Department of Medicine,
Brooke Army Medical Center

by

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February 1985

Introduction

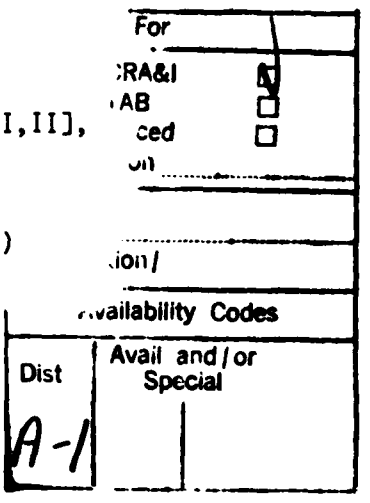
Based on a request from Dr. John Carpenter, COL, MC, Chief, Department of Medicine, Brooke Army Medical Center, a statistical consultation was performed to determine significant variables affecting the rate of surgeons' compliance with recommendations resulting from consultations with internists. The request for analytical support was based on a six month study of compliance which produced data on 419 consultations, resulting in 1705 recommendations. The study was performed by Dr. Larry Pupa, CPT, MC, Fellow, Cardiology Service and involved recommendations by several residents. One purpose of the study was to evaluate the effects of implementing results from a major study of compliance factors reported by Sears and Charlson (1983).

Raw data was provided to HCSCIA in hard copy form. The data was edited by HCSCIA personnel as it was entered into the computer for analysis and many coding inconsistencies were discovered. These problems were resolved with Department of Medicine personnel resulting in 419 "good consults" upon which to base the analysis. All statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS). A summary of the important statistical results is provided in the remainder of this report.

Variables Analyzed

CONSULT SPECIFIC:

AGE - Age of Patient (1-99)
SEX - Sex of Patient (M or F)
TIME - Time of Consult (Preop, Postop, or Postop > 24 hours)
CLINDEX - Clinical Index of Patient based on McCabe or Anes (A[I,II], B[III], or C[IV,V])
SPDX - Sub-specialty Area of Diagnosis (10 sub-specialties)
NREC - Number of Recommendations (Size of List 1-8)
CONT - Contact with Surgeon (Immediate, After 24 hours, or None)



RECOMMENDATION SPECIFIC:

CRUC - Importance (Crucial or Non-Crucial)
FOLL - Compliance (Followed or Not Followed)
TREC - Type of Recommendation (Diagnostic or Therapeutic)
PROC - Procedure (None, Procedure by MD, or Procedure by RN)
DRTP - Drug Type (None or 7 types of drugs)
DRMN - Drug Manipulation (None, Start, Stop, Continue, or Adjust)

Statistical Analysis

Differences between proportions were assessed using the chi-square test of independence when sample size was sufficient and with Fisher's Exact Test when sample size was small. Differences between means of continuous variables were evaluated using two-tailed t tests for two groups and analysis of variance F ratios for more than two groups. Two-group discriminant analyses were performed to evaluate the relative importance of various consult and recommendation characteristics for predicting compliance. In most cases, a 0.02 level of significance was required as the judge of statistical significance of results to reduce the impact of multiple tests on overall statistical error rates. Exceptions are noted and exact p-values are reported. It should be carefully noted that in the analysis of individual recommendations (n=1705), the assumption of independent observations required by the chi-square test was violated in that multiple recommendations on an individual patient cannot realistically be considered as independent trials. This may result in an artificially inflated sample size for some chi-square tests and, potentially, artificially inflated significance levels (smaller p values).

Results of Analysis

OVERALL:

Tables 1 and 2 provide an overall descriptive analysis of variables which turned out to be "worth" analyzing. Characteristics of the 419 consultations

Table 1

CHARACTERISTICS OF 419 CONSULTATIONS

Variable	Consults	Recommendations Per Consult	Recommendations Followed Crucial	Non Crucial	Total
SEX					
M	211/419 (50.4%)	4.2	120/126 (95.2%)	678/ 759 (89.3%)	798/ 885 (90.2%)
F	208/419 (49.6%)	3.9	102/105 (97.1%)	640/ 715 (89.5%)	742/ 820 (90.5%)
	T 419/419 (100%)	4.1	222/231 (96.1%)	1318/1474 (89.4%)	1540/1705 (90.3%)
AGE					
<60	174/417 (41.7%)	3.9	84/ 86 (97.7%)	532/ 587 (90.6%)	616/ 673 (91.5%)
>60	243/417 (58.3%)	4.2	134/140 (95.7%)	784/ 884 (88.7%)	918/1024 (89.6%)
	T 417/417 (100%)		218/226 (96.5%)	1316/1471 (89.5%)	1534/1697 (90.4%)
TYPE CONSULT					
Spec Mgt	176/418 (42.1%)	4.4	100/100 (100%)	606/ 672 (90.2%)	706/ 772 (91.5%)
General	63/418 (15.1%)	4.6	41/ 44 (93.2%)	217/ 248 (87.5%)	258/ 292 (88.4%)*
Preop Clr	179/418 (42.8%)	3.5	77/ 82 (93.9%)	494/ 551 (89.7%)	571/ 633 (90.2%)
	T 418/418 (100%)		218/226 (96.5%)	1317/1471 (89.5%)	1535/1697 (90.5%)
CLINICAL SEVERITY					
ASA I&II	114/419 (27.2%)	3.2	24/ 25 (96.0%)	302/ 344 (87.8%)	326/ 369 (88.3%)
ASA III	253/419 (60.4%)	4.3	145/148 (98.0%)	844/ 935 (90.3%)	989/1083 (91.3%)
ASA IV&V	52/419 (12.4%)	4.9	53/ 58 (91.4%)	172/ 195 (88.2%)	225/ 253 (88.9%)
	T 419/419 (100%)		222/231 (96.1%)	1318/1474 (89.4%)	1540/1705 (90.3%)

*Significantly lower, p = 0.018

Table 1 (Contd)

CHARACTERISTICS OF 419 CONSULTATIONS

Variable	Consults	Recommendations Per Consult	Recommendations Followed Crucial	Non Crucial	Total
SIZE OF LIST					
1-5	324/419 (77.3%)	3.2	121/125 (96.8%)	834/ 923 (90.4%)	955/1048 (91.2%)
>5	95/419 (22.7%)	6.9	101/106 (95.3%)	484/ 551 (87.8%)	585/ 657 (89.0%)
	T 419/419 (100%)		222/231 (96.1%)	1318/1474 (89.4%)	1540/1705 (90.3%)
CONTACT W/SURGEON					
Same Day	298/418 (71.3%)	4.2	198/205 (96.6%)	925/1038 (89.1%)	1123/1243 (90.3%)
After 24 hours	89/418 (21.3%)	4.0	19/ 21 (90.5%)	302/ 337 (89.6%)	321/ 358 (89.7%)
None	31/418 (7.4%)	3.1	5/ 5 (100%)	83/ 91 (91.2%)	88/ 96 (91.7%)
	T 418/418 (100%)		222/231 (96.1%)	1310/1466 (89.4%)	1532/1697 (90.3%)

Table 2

ADDITIONAL CHARACTERISTICS OF 1705 RECOMMENDATIONS

Variable	Recommendations	Recommendations Per Consult	Recommendations Followed Crucial	Non Crucial	Total
IMPORTANCE					
Crucial	231/1705 (13.5%)	0.6	222/231 (96.1%)		222/ 231 (96.1%)[1]
Non Crucial	1474/1705 (86.5%)	3.5		1318/1474 (89.4%)	1318/1474 (89.4%)
	T 1705/1705 (100%)	4.1	222/231 (96.1%)	1318/1474 (89.4%)	1540/1705 (90.3%)
TYPE					
Diagnostic	963/1705 (56.5%)	2.3	123/129 (95.3%)	719/ 834 (86.2%)	842/ 963 (87.4%)
Therapeutic	742/1705 (43.5%)	1.8	99/102 (97.1%)	599/ 640 (93.6%)	698/ 742 (94.1%)[2]
	T 1705/1705 (100%)		222/231 (96.1%)	1318/1474 (89.4%)	1540/1705 (90.3%)
PROCEDURE					
None	1243/1705 (72.9%)	3.0	168/170 (98.8%)	958/1073 (89.3%)	1126/1243 (90.6%)
Physician	359/1705 (21.1%)	0.9	45/ 51 (88.2%)	272/ 308 (88.3%)	317/ 359 (88.3%)
Nurse	103/1705 (6.0%)	0.2	9/ 10 (90.0%)	88/ 93 (94.6%)	97/ 103 (94.2%)
	T 1705/1705 (100%)		222/231 (96.1%)	1318/1474 (89.4%)	1540/1705 (90.3%)
DRUG MANIP-ULATION					
None	1291/1703 (75.8%)	3.1	152/160 (95.0%)	1000/1131 (88.4%)	1152/1291 (89.2%)[3]
Start	182/1703 (10.7%)	0.4	37/ 38 (97.4%)	130/ 144 (90.3%)	167/ 182 (91.8%)
Stop	50/1703 (2.9%)	0.1	8/ 8 (100%)	38/ 42 (90.5%)	46/ 50 (92.0%)
Continue	92/1703 (5.4%)	0.2	8/ 8 (100%)	84/ 84 (100%)	92/ 92 (100%)
Adjust	88/1703 (5.2%)	0.2	15/ 15 (100%)	66/ 73 (90.4%)	81/ 88 (92.0%)
	T 1703/1703 (100%)		220/229 (96.1%)	1318/1474 (89.4%)	1538/1703 (90.3%)

1. Significantly higher, p = 0.0014
2. Significantly higher, p = 0.0001
3. Significantly lower, p = 0.0080

and the resulting 1705 recommendations are displayed. Totals are provided in each section of the tables to indicate the presence of missing observations. Compliance is shown separately for Crucial and Non-Crucial recommendations based on importance to subsequent analysis. Results of specific statistical comparisons and additional analyses are given below.

CONSULT SPECIFIC (N = 419):

Tables 3 and 4 display the distribution of the overall number of recommendations and number of crucial recommendations across the 419 consults. It is noteworthy that more than 75% of the lists were no longer than five recommendations and less than 10% of the lists contained greater than two crucial recommendations.

Interesting relationships between the size of consult lists and the Type of Consult, Clinical Index of the patient, and Contact with Surgeons are shown in Table 5. Preop Clearance consults tend to result in significantly fewer recommendations than Specific Management Problems or General consults ($p = 0.0128$); McCabe B and C patients require significantly more recommendations than McCabe A patients ($p = 0.0001$); while there is a tendency for immediate contact to increase with the length of the list. This last relationship is not statistically significant ($p = 0.0682$) but is certainly intuitive. These relationships are maintained even when the Size of List is not collapsed into two categories and appear to be quite linear with the number of recommendations.

Tables 6 and 7 display the distributions of overall per patient compliance with recommendations from the 419 consults and compliance with crucial recommendations for the 101 patients who had crucial recommendations, respectively. It is noteworthy that in fewer than 10% of the cases shown in Table 7 were less than 100% of the crucial recommendations followed.

Table 3

FREQUENCY DISTRIBUTION OF ALL RECOMMENDATIONS

NREC	Freq	Percent	Cumm Percent
1	38	9.1%	9.1%
2	62	14.8%	23.9%
3	74	17.7%	41.5%
4	86	20.5%	62.1%
5	64	15.5%	77.3%
6	40	9.5%	86.9%
7	21	5.0%	91.9%
8	34	8.1%	100.0%
	419	100.0%	

Table 4

FREQUENCY DISTRIBUTION OF CRUCIAL RECOMMENDATIONS

NCREC	Freq	Percent	Cumm Percent
0	318	75.9%	75.9%
1	45	10.7%	86.6%
2	20	4.8%	91.4%
3	13	3.1%	94.5%
4	12	2.9%	97.4%
5	7	1.7%	99.1%
6	3	0.7%	99.8%
7	1	0.2%	100.0%
8	0	0.0%	100.0%
	419	100.0%	

Table 5

RELATIONSHIPS WITH SIZE OF LIST

Size of List	Type of Consult			Clinical Index			Contact with Surgeon		
% Lists of Size:	Spec Mgt Prob	General Consult	Preop Clearance	McCabe A	McCabe B	McCabe C	Immediate	After 24 hours	None
1 - 5	73.3%	69.8%	84.4%	91.2%	73.1%	67.3%	75.5%	78.7%	93.5%
> 5	26.7%	30.2%	15.6%	8.8%	26.9%	32.7%	24.5%	21.3%	6.5%

Table 6

OVERALL PER PATIENT COMPLIANCE RATE

Compliance Rate	Freq	Percent	Cumm Percent
0 - 49%	5	1.2%	1.2%
50 - 74%	57	13.6%	14.8%
75 - 99%	53	12.6%	27.4%
100%	304	72.6%	100.0%
	419	100.0%	

Table 7

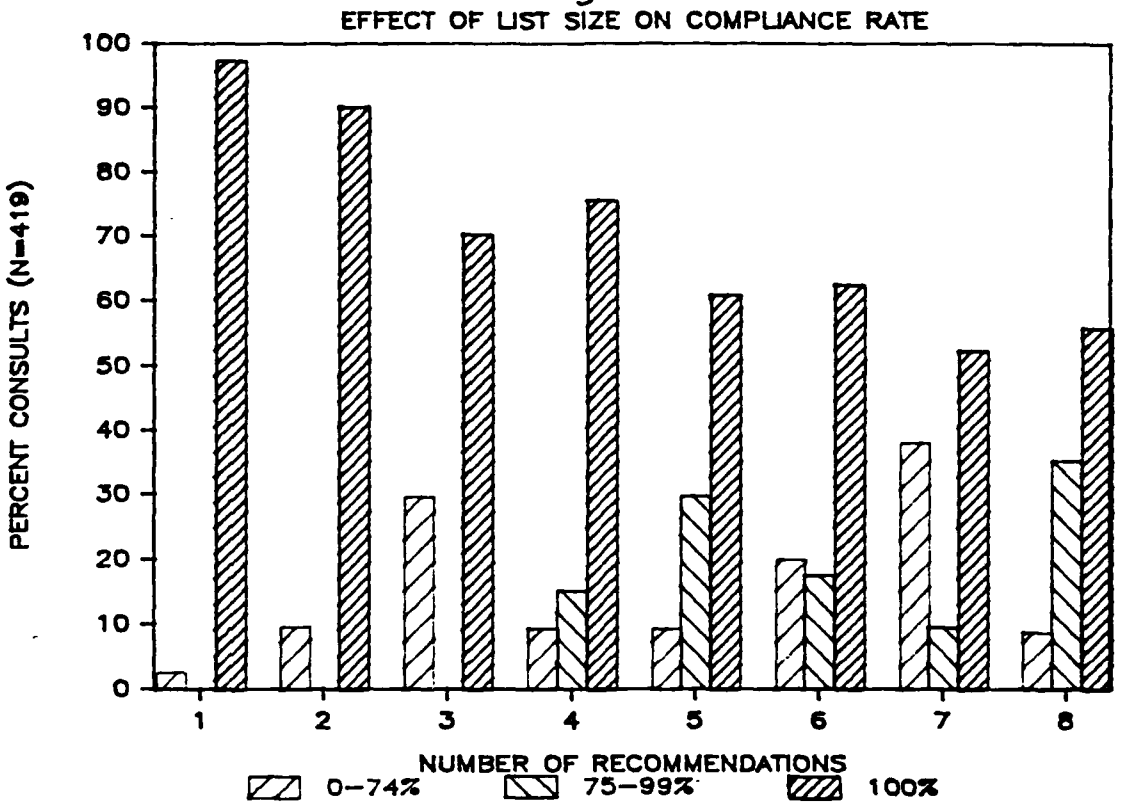
PER PATIENT CRUCIAL RECOMMENDATION COMPLIANCE RATE

Compliance Rate	Freq	Percent	Cumm Percent
0 - 49%	4	3.96%	3.96%
50 - 74%	1	0.99%	4.95%
75 - 99%	4	3.96%	8.91%
100%	92	91.09%	100.00%
	101	100.00%	

There was a weak but statistically significant correlation between per patient compliance rate and number of recommendations ($n = 419$, $r = -0.1324$, $p = 0.003$). This relationship is further illustrated in Figure 1 which shows list size from 1 to 8 and compliance rate categorized as follows: 0-74%, 75-99%, and 100%. Percent of consults falling into each category is displayed on the verticle axis. A chi-square analysis of these frequencies revealed a highly significant relationship (chi-square = 90.4, d.f. = 14, $p < 0.0001$). In fact, a simple correlation between number of recommendations and percent of consults with 100% compliance produced $r = -0.9322$ ($n = 8$, $p < 0.001$).

Other interesting per consult results include the following. The General type consults showed a lower overall compliance rate than other types combined. (Fisher's Exact Test, $p = 0.018$) A two group discriminant analysis (100% compliance versus less than 100% compliance) demonstrated the statistically significant ability of Age (<60 vs. >60), Type of Consult (General vs. Other), Clinical Index of Patient (B vs. Other), and Size of List (1-5 vs. >5) to predict compliance. However, only 61% of the 419 consults were correctly classified using the model with these variables. One would do better simply predicting 100% compliance in all cases with an overall successful classification

Figure 1



rate of 73%. No other statistically significant relationships were found in the per consult analysis.

RECOMMENDATION SPECIFIC (N = 1705):

Analysis of all appropriate variables and their effect on compliance with individual recommendations was conducted. Most of the applicable descriptive statistics were displayed in Tables 1 and 2 and will not be repeated here. Once again it should be noted that the 1705 recommendations are not independent observations and the statistical results should be interpreted with caution.

However, most of the results are intuitive and supported by previous research and many are highly significant.

In the analysis of overall compliance with the 1705 individual recommendations, the variables Age, Sex, Time of Consult, Type of Consult, Clinical Index, Subspecialty Diagnosis, Number of Recommendations, Procedures, and Contact with Surgeon were not significantly related to compliance. Whether or not a recommendation was denoted as Crucial had a significant impact on compliance (96.1% for Crucial versus 89.4% for Non-Crucial, $p = 0.0014$). There was also a significant difference between compliance rates for Diagnostic versus Therapeutic recommendations (87.4% versus 94.1%, $p = 0.0001$). Recommendations involving Drugs were followed a significantly higher percentage of the time (93.6% versus 89.2% for Non-Drug recommendations, $p = 0.008$). In addition, for those recommendations involving drug therapy, it made a "close to " significant difference as to what action was called for. Compliance with "Continue" recommendations was 100% whereas Start, Stop, or Adjust recommendations were followed about 92% of the time ($p = 0.0479$).

Since the impact of specifying that a recommendation was Crucial appeared so significant, it was decided to analyze this variable in two different ways. First, an analysis of the impact of all other variables on compliance was conducted separately for Crucial versus Non-Crucial recommendations. These results may be summarized as in Table 8.

The significant relationships indicated include the following. Type of Consult: One-hundred percent of the Crucial recommendations for Specific Management Problems were complied with compared to 93.7% compliance with other types of consults ($p = 0.008$). This indicates a greater tendency for surgeons to follow important recommendations concerning problems they themselves have

Table 8

IMPACT OF VARIABLES ON COMPLANCE RATE
CONTROLLING FOR CRUCIAL VERSUS NON-CRUCIAL

VARIABLE	Importance of Recommendation	
	NON-CRUCIAL	CRUCIAL
Age	N.S.	N.S.
Sex	N.S.	N.S.
Time of Consult	N.S.	N.S.
Type of Consult	N.S.	S.
Clinical Index	N.S.	N.S.
Sub-Specialty Dx	N.S.	N.S.
Size of List	N.S.	N.S.
Contact w/Surgeon	N.S.	N.S.
Type Recommendation	S.	N.S.
Procedures	N.S.	S.
Drug (versus None)	S.	N.S.

S. = Significant
N.S. = Not Significant

identified. Type of Recommendation: Whether a recommendation was Diagnostic or Therapeutic made a significant difference in compliance with Non-Crucial recommendations (86.2% versus 93.6%, p = 0.0001) but this difference was not significant for Crucial recommendations (95.3% versus 97.1%). This may mean that Crucial or not is more important than the nature of the recommendation. Procedures: When a procedure was suggested, only 88.5% of the Crucial recommendations were followed, whereas Crucial recommendations not involving procedures were complied with 98.8% of the time (p = 0.0003, but there were only 61 of the 1705 recommendations which were for crucial procedures). Drug: Finally, for Non-Crucial recommendations, whether or not a drug was prescribed significantly impacted on compliance (92.7% versus 88.4% for no drug, p = 0.0235). This variable had no significant effect on compliance with Crucial recommendations.

To further explore the importance of indicating that a recommendation was Crucial, an attempt was made to separately examine this impact within categories of the other variables. These results are summarized in Table 9. P values are shown in all cases of statistical significance. Crucial versus Non-Crucial made a significant difference in compliance on both lists of five or less and greater than five recommendations. Crucial made a difference within Diagnostic but not Therapeutic recommendations. This significance was repeated within recommendations involving Immediate Contact with Surgeons but it is not clear which is the dependent variable in this instance. Crucial recommendations for Specific Management Problems were followed a significantly greater percentage of the time than Non-Crucial recommendations for similar situations. This is important in that even in these cases where surgeons have made specific requests, indicating that the recommendation is Crucial still makes a significant difference. Finally, Crucial made a significant difference when No Drug was involved in the recommendation but not in the case of Drug involvement. This is, of course, due to the overall high compliance rate for Drug recommendations in general.

The final statistical analysis was a two group (followed or not) discriminant analysis of the variables effecting compliance with the 1705 individual recommendations. The variables Crucial, Number of Recommendations, and Type of Recommendation were significant in this analysis but, once again, the classification results of this model were poor with only 57% of the overall recommendations being correctly assigned.

Table 9

IMPACT OF CRUCIAL RECOMMENDATIONS ON COMPLIANCE RATE
CONTROLLING FOR OTHER VARIABLES

Variable	Compliance Rate within Category					
Number of Recommendations	Five or Less		More than Five			
	Crucial	Non-Crucial	Crucial	Non-Crucial		
	96.8%	90.4%	95.3%	87.8%		
	(p = 0.0174)		(p = 0.0247)			
Type Recommendation	Diagnostic		Therapeutic			
	Crucial	Non-Crucial	Crucial	Non-Crucial		
	95.3%	86.2%	97.1%	93.6%		
	(p = 0.0036)		(not significant)			
Contact with Surgeon	Immediate		After 24 Hours		None	
	Crucial	Non-Crucial	Crucial	Non-Crucial	Crucial	Non-Crucial
	96.6%	89.1%	90.5%	89.1%	(sample too small)	
	(p = 0.0009)		(not significant)			
Clinical Index	A(I, II)		B(III)		C(IV, V)	
	Crucial	Non-Crucial	Crucial	Non-Crucial	Crucial	Non-Crucial
	96.0%	87.8%	98.0%	90.3%	91.4%	88.2%
	(not significant)		(p = 0.0020)		(not significant)	

Table 9 (Contd)

IMPACT OF CRUCIAL RECOMMENDATIONS ON COMPLIANCE RATE
CONTROLLING FOR OTHER VARIABLES

Variable	Compliance Rate within Category					
Type of Consult	Specific Mgt Problem		General		Pre-op	
	Crucial	Non-Crucial	Crucial	Non-Crucial	Crucial	Non-Crucial
	100.0%	90.2%	93.2%	87.5%	93.9%	89.7%
	(p = 0.0010)		(not significant)		(not significant)	
Drug Recommendation	No		Yes			
	Crucial	Non-Crucial	Crucial	Non-Crucial		
	95.0%	88.4%	98.6%	92.7%		
	(p = 0.0119)		(not significant)			

Reference

Sears, Cynthia L., and Charlson, Mary E. "The Effectiveness of a Consultation: Compliance with Initial Recommendations" The American Journal of Medicine. 1983, 74: 870-876.

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